Application Level Networking:
Network Monitoring and Bridging

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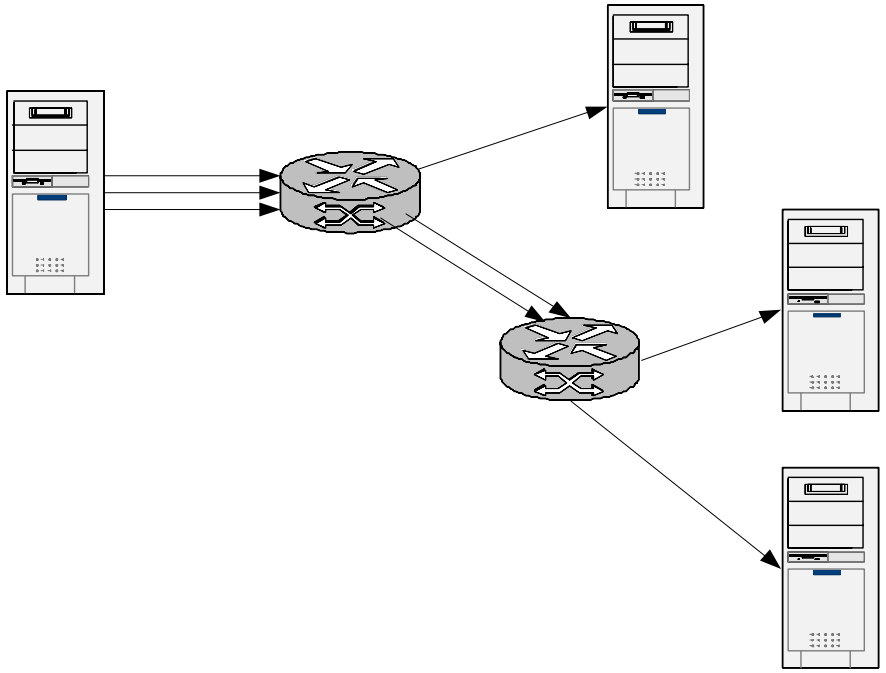
Agenda

- Multicast overview
- Monitoring and Bridging
- ALM in the AccessGrid
- Future Plans

Multicast Overview

- Multicast was specifically designed to solve the problem of multipoint media distribution

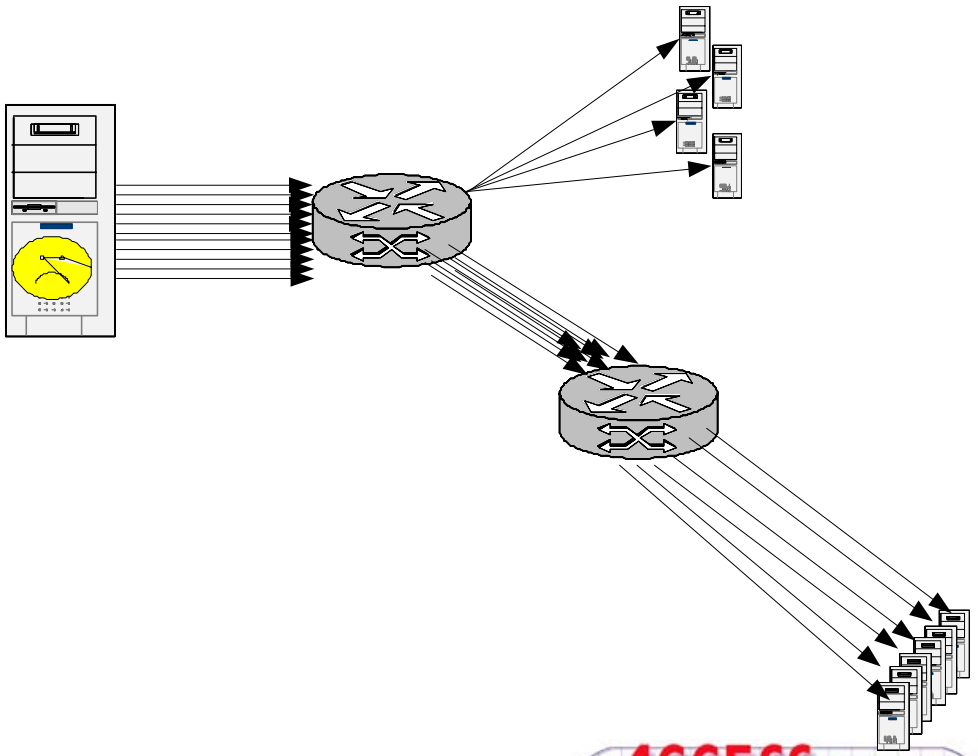
- Unicast
  - + A copy of the data is sent to each recipient



Multicast Overview

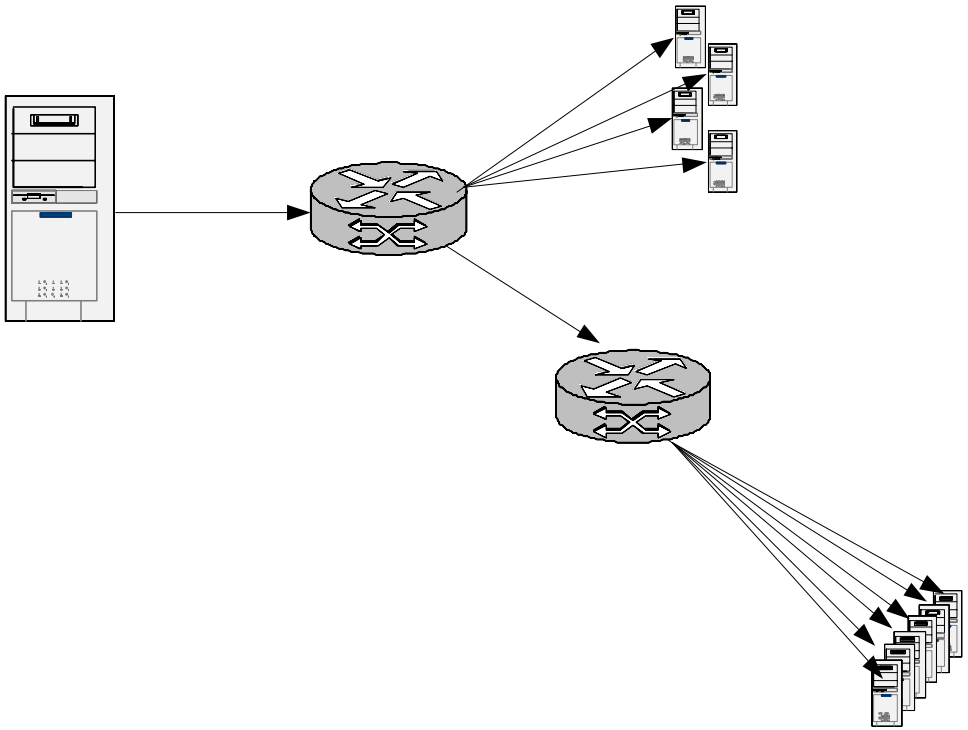
- Multicast was specifically designed to solve the problem of multipoint media distribution

- Unicast
  - + A copy of the data is sent to each recipient
  - – Bandwidth consumption is proportional to number of recipients
  - – Source host copying scales with number of recipients



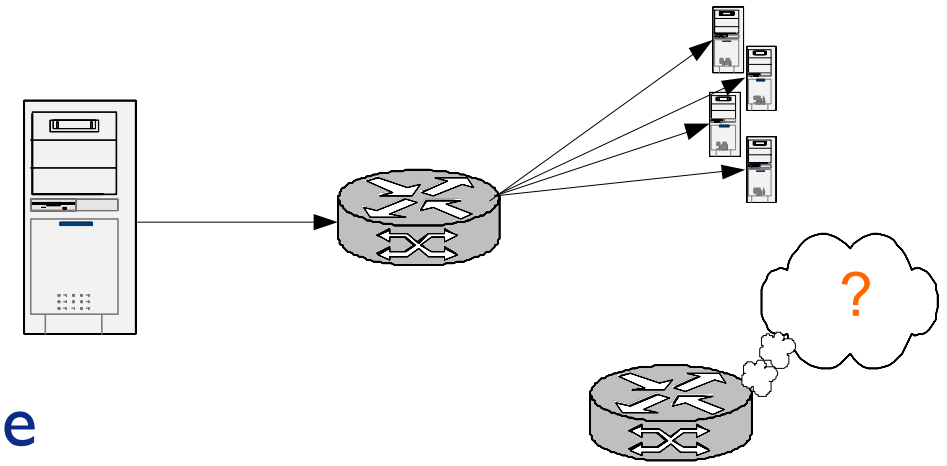
Multicast Overview

- Multicast
  1. One copy of the data is sent over the network
  2. Only subscribers receive the data



Multicast Overview

- Multicast
  1. One copy of the data is sent over the network
  2. Only subscribers receive the data
  - Not stable
  - Not standard service of providers
  - Not available to everyone



Multicast Problems

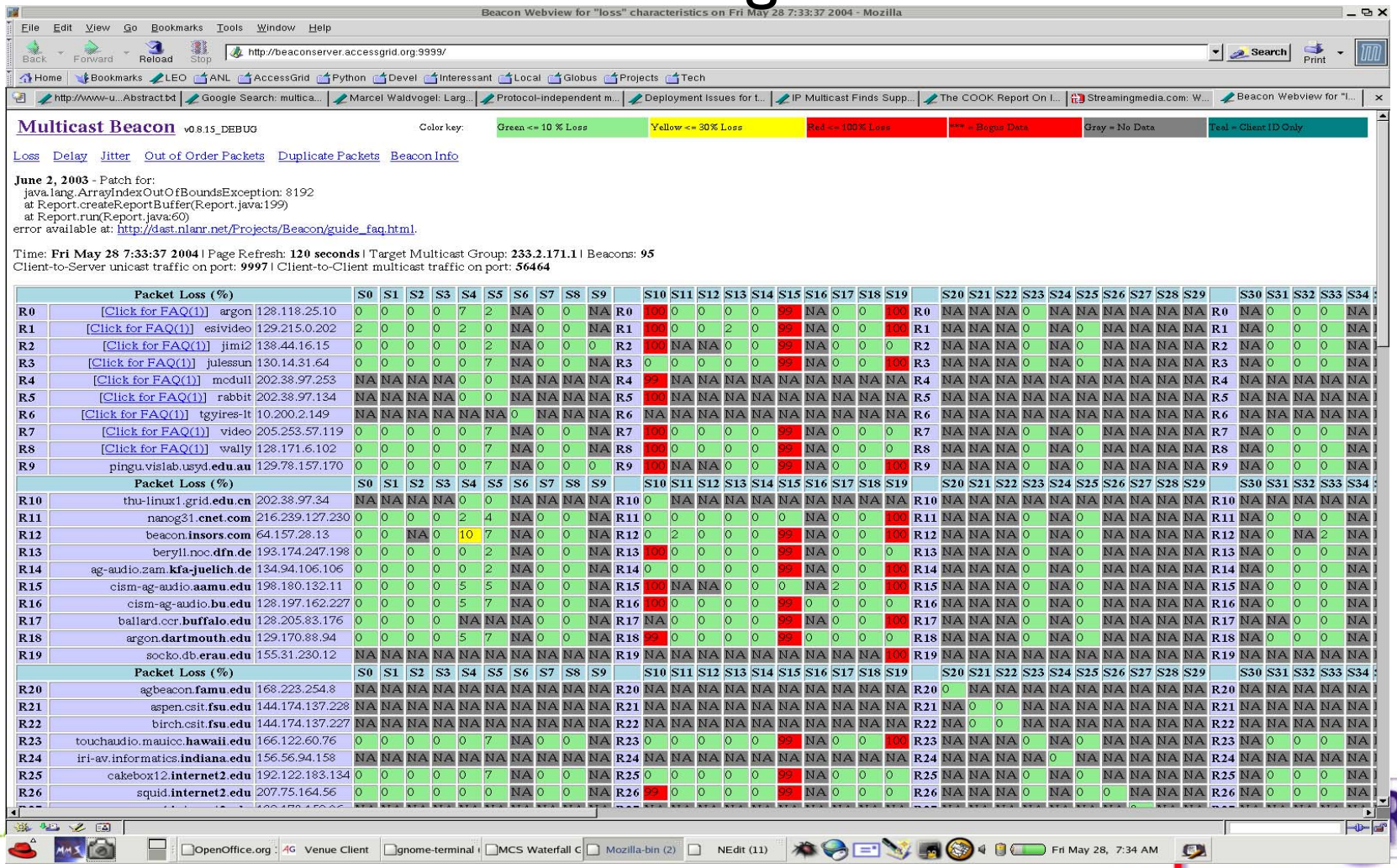
- Multicast failures compromise the usability of the AccessGrid:
  - Poor audio quality
  - Irregular, pixelated video
  - No audio, video
- Problems are often transient and difficult to debug

What can be done to overcome these problems?

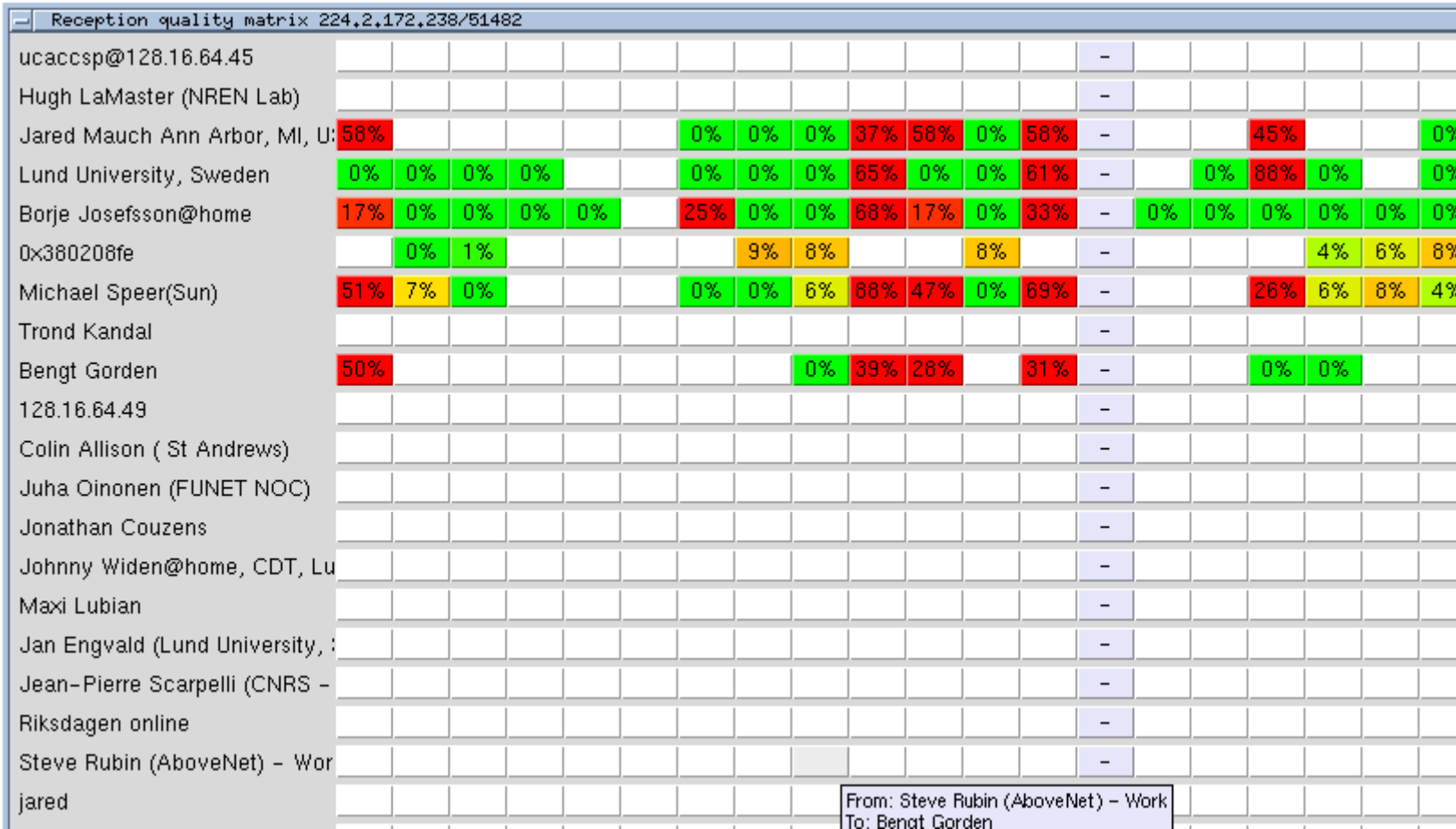
Monitoring
(Understanding the Problem)

- NLANR Multicast Beacon
  - Multicast monitoring tool
  - Provides measurement of current multicast connectivity
    - Loss -- percentage of packet loss from one client to another
    - Delay -- one-way delay (in milliseconds) from one client to another
    - Jitter -- variation (in milliseconds) of the one-way delay
    - Order -- percentage of packets which arrived out-of-order
    - Duplicate -- percentage of duplicate packets
  - Used by a large portion of the AccessGrid community to identify and locate loss

Monitoring
(Understanding the Problem)
Beacon Server Statistics Page

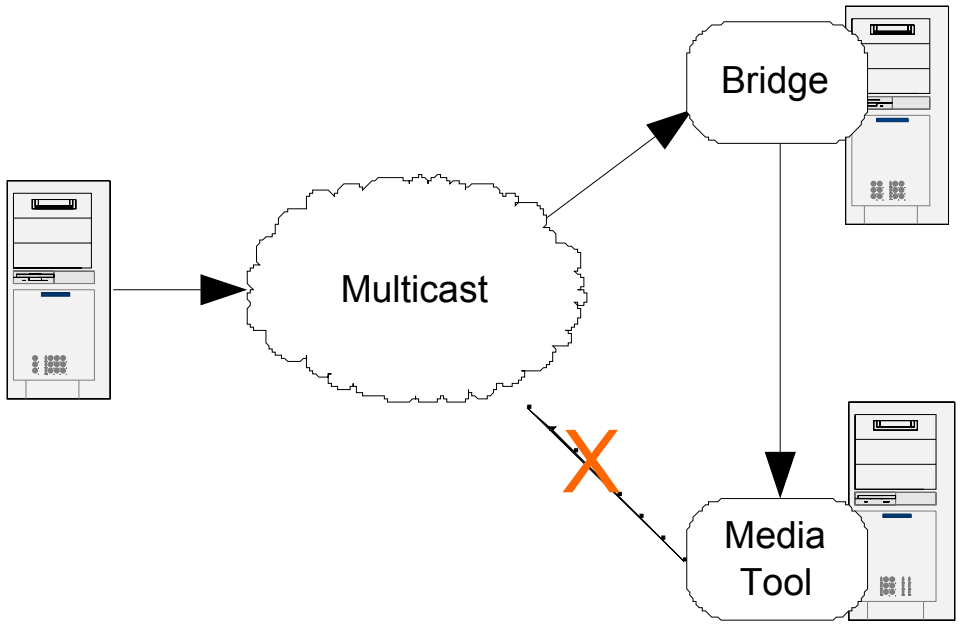


Monitoring
(Understanding the Problem)
RAT – Reception Quality Matrix



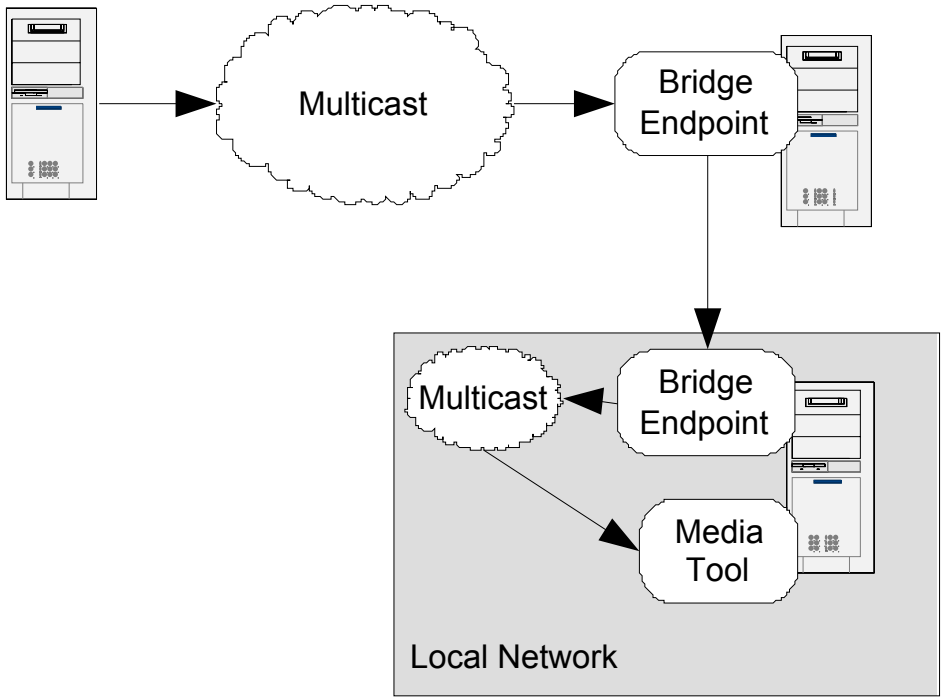
Bridging
(Overcoming the Problem)

- Tunneling
  - Provide access to the multicast group over a unicast connection from well-connected client to disconnected or poorly connected client



Bridging
(Overcoming the Problem)

- Application-level Multicast (ALM)
  - Create a tunnel to a host with working multicast
  - Send packets to multicast on local network
  - On the local network, multicast appears to work properly
  - Avoids reconfiguration of media tool

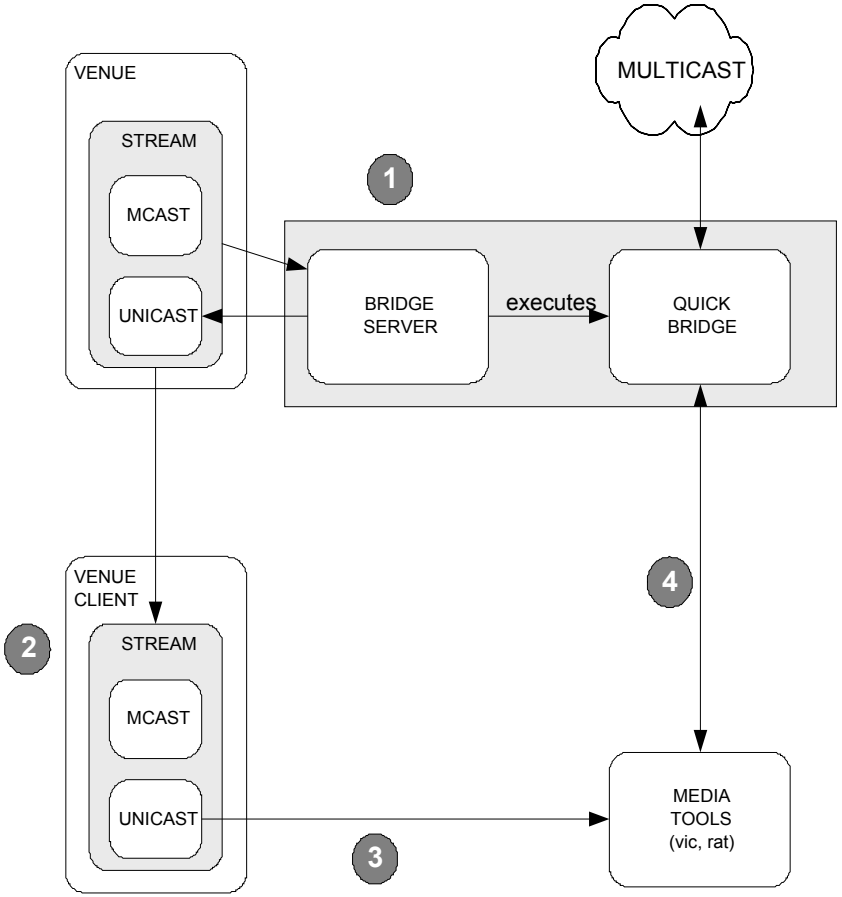


Bridging AccessGrid media

- The Access Grid community has used the following bridging solutions:
  - QuickBridge, Multisession Bridge
    - Forward traffic between multicast and unicast peers
    - Can peer with another instance to repair local multicast
  - rcbridge/rcb-forward
    - As above
    - Web-based source selection
    - Being actively developed

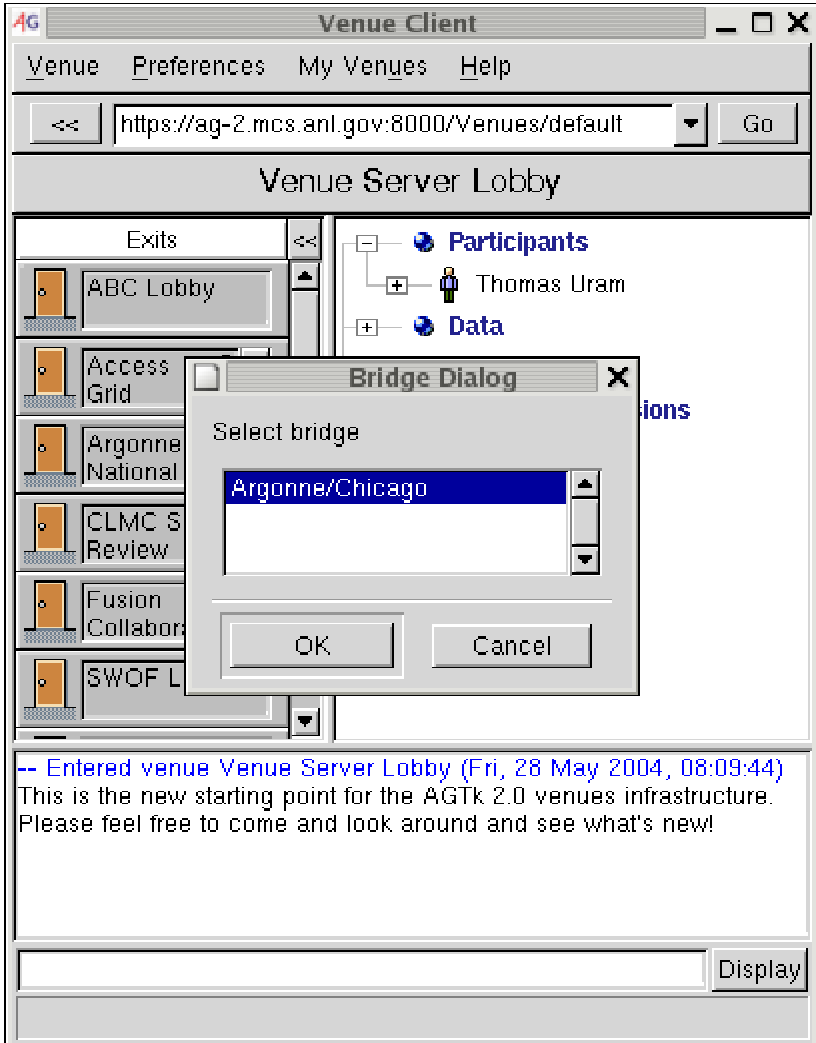
BridgeServer
(Integrating the Overcoming)

1. BridgeServer gets stream info from Venue, starts QuickBridge, and adds the bridge location to the venue stream
2. VenueClient enters the venue and gets stream info
3. User selects the unicast stream, which is passed to media tool
4. Media tool begins exchanging data with QuickBridge



BridgeServer
VenueClient Integration

- VenueClient allows user to choose from available bridges
- Media tools are restarted, pointed at the bridged addresses



Future Plans

- Improve bridging integration
- Integrate monitoring
- Automatic Bridging

Improve Bridge Integration

- Improve usability of integrated bridging
  - Enable users to provide bridges from the venue client
  - Enable interactive configuration of bridges (currently static)
- Deploy integrated ALM solution
- Consider alternate bridging solutions
  - UDP Multicast Tunneling Protocol (UMTP), live.com
  - Intergroup, LBNL
  - ASPEN, UC Berkeley
  - rcbridge, Australian National University

Integrate Monitoring

- Integrate with VenueClient
  - Limit scope of monitoring to venue participants
  - Display connectivity status
    - Clarify *where* multicast is failing: "My multicast is broken; I should bridge"
    - Quantify failure: from "Your video is very sporadic" to "I'm seeing 40% loss from you"
- Monitor connectivity of beacon channel and media channels
- Aggregate statistics across venues for analysis of the larger scope
- Record details over time for analysis of connectivity history

Automatic Bridging

- Use connectivity monitoring to characterize multicast quality and identify where the network is failing
- Trigger connection to bridge, based on user preferences and heuristics
- Detect recovery of multicast and switch back

Credits

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